

Comments—NBP Public Notice #2

GN Docket Nos. 09-47, 09-51 and 09-137

COMMENTS OF THE ZIGBEE ALLIANCE

The ZigBee Alliance appreciates the opportunity to provide below its contribution to the current FCC effort to understand the implementation of Smart Grid technology. What follows is a brief summation and comment on certain networking technologies related to the Home Area Network and ZigBee mesh networking. The Alliance would be pleased to provide further, more detailed information and comment, and notes the ZigBee Smart Energy profile was selected by NIST as one its smart grid standards in its initial standards selection, and following again in its most recent standards roadmap released in September 2009.

Selected questions are answered below in sections 1, 3, 4 and 5, and are repeated for clarity, with responses in italics.

1. Suitability of Communication Technology

- Specific network requirements for applications in the grid (latency, bandwidth, reliability, coverage, others)

Smart grid applications addressing the connection between the grid to the home, consumer, industrial and commercial premises involve the connection of disparate devices and resources. This application area creates unique requirements on networking, addressed by existing and evolving technologies and markets.

The Smart Grid as a system is a highly complex one and can be thought of as a super-system of numerous smaller systems. Some of these systems are control systems, which may need almost instantaneous feedback over a small geographical area to maintain stability. Others are much more open loop and therefore have less strict latency and guaranteed delivery requirements. Some of these systems are enterprise software systems, which require the frequent transfer of large amounts of data over a wide geographical area and thus require significant bandwidth, others require more infrequent transfer of small amounts of data to intelligent smart objects in industrial and consumer premises. However, the factor specifically distinguishing the smart grid is the high degree of interconnectivity between these systems. Therefore it is critical

to the success of the smart grid that these data can be universally understood by the systems which they cross and that the security of the data is maintained throughout.

Considering specifically the home area network environment: the data transacted here may be local to the premise but will typically extend into AMI systems owned and managed by utilities. The amount of data is relatively small and the transactions relatively infrequent. The integrity and authenticity of the data for certain critical operations is paramount and often the data needs to be confidential.

Specifically, this Home Area Network (HAN) creates an environment of sensors and control devices with unique needs. In general, these sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays. These requirements have been demonstrated in multiple implementations by utilities as part of their Advanced Metering Infrastructure deployments, and through multiple venues in requirements gathering to address just such technology. The ZigBee Alliance has taken the lead in the smart energy to develop and proliferate global, open standards to support these network requirements. ZigBee is currently working to further enhance these standards with the incorporation of IETF standards on 6LoWPAN and ROLL routing. We cite the following technical documents which provide details on these specific requirements:

- ZigBee Smart Energy Public Application Profile –
<http://www.zigbee.org/ZigBeeSmartEnergyPublicApplicationProfile/tabid/312/Default.aspx>
The ZigBee Smart Energy public application profile provides standard interfaces and device definitions to allow easy interoperability among ZigBee Smart Energy devices produced by various manufacturers.
- ZigBee/HomePlug Smart Energy Market Requirements Document (MRD), enhancement to the ZigBee Smart Energy Profile -
<http://www.zigbee.org/Markets/ZigBeeSmartEnergy/ZigBeeSmartEnergyOverview/ZigBeeHomePlugSmartEnergyMRDRequest/tabid/449/Default.aspx>
This MRD details the next generation of functionality and use cases envisioned for the Smart Grid with accompanying consumer control.
- ZigBee Specification including Pro Stack Feature Set-
<http://www.zigbee.org/ZigBeeSpecificationDownloadRequest/tabid/311/Default.aspx>
- What communications and network technologies meet these requirements?
Considering specifically the home area network environment: the devices in the premises may well need to be battery powered and may be located in inaccessible places thus favoring the use of low power wireless technologies such as 802.15.4 and enabling mesh networking technologies such as ZigBee.

ZigBee uses IEEE 802.15.4, and is in the process of developing protocols to leverage the IETF Internet Protocol, specifically ROLL and 6LoWPAN relevant to Smart Grid uses. The ZigBee specification has the following key technical characteristics:

- Dual PHY (2.4GHz and 868/915 MHz)
 - Data rates of 250 kbps (@2.4 GHz), 40 kbps (@ 915 MHz), and 20 kbps (@868 MHz)
 - Optimized for low duty-cycle applications (<0.1%)
 - CSMA-CA channel access
 - **Yields high throughput and low latency for low duty cycle devices like sensors and controls**
 - Low power (battery life multi-month to years)
 - Multiple topologies: star, peer-to-peer, mesh
 - Addressing space of up to:
 - **65,535 possible devices within a network**
 - Existing field networks of hundreds of devices in a home to thousands and hundreds of thousands of nodes in neighborhood or city wide networks.
 - Fully hand-shaked protocol for transfer reliability
 - Range: 50m typical (5-500m based on environment)
- What types of network technologies are most commonly used in Smart Grid applications?

The Smart Grid as a term is a new phenomenon, but captures many existing technologies, to drive intelligence further in to the power grid (all energy types), and optimize safety, reliability and management of those resources. The ZigBee Alliance works with multiple technologies in use in the Smart Grid. For the HAN, utilities have announced more than 30 million utility meters will use ZigBee wireless protocol, leveraging 2.4GHz wireless radios. In addition, ZigBee has worked with the HomePlug Alliance to address powerline technology for HAN applications.

One of the first enabling technologies in the Smart Grid is AMI (Advanced Metering Infrastructure). This requires communication from utilities' offices right into consumers' premises. In essence, this can be considered in three domains:

- *The wide area network (WAN) linking the utilities' offices to geographical neighborhood collector points (typically pole-top or substation nodes)*
- *The neighborhood area network (NAN) linking the collector points to a premise gateway node, usually a meter*
- *The home area network (HAN) linking the premise gateway node to all the additional nodes in the premise, such as programmable thermostats, price*

displays, pool pumps, HVAC controllers, primarily for the purposes of demand response and load control

The most common network technologies used in the HAN is low power wireless technologies such as ZigBee Smart Energy and also powerline technologies such as HomePlug.

- Are current commercial communications network adequate?
The ZigBee Alliance has drawn from hundreds of stakeholders to address network adequacy to address needs in residential, commercial and industrial environments. For the Home Area Network topology, existing communications networks were not appropriate or sufficient to gain the benefits and value of the HAN. The ZigBee protocol has leveraged the experience of product manufacturers, end-customers, utilities and from other requirements and use cases to address that gap, with the result being multiple and quickly increasing implementations globally.

For the HAN, prior to the development of low-power wireless technology, the possible alternatives were either more power-hungry solutions more suited to LANs (local area networks) or solutions limited to a very small number of devices and more suited for phone to headset communication. The introduction of ZigBee and 802.15.4 became ideally suited for the HAN environment and is thus available and adequate today.

- How reliable are commercial wireless networks for carrying Smart Grid data?
ZigBee uses mesh networking to provide self-healing reliable networks. 802.15.4 uses spread spectrum communications at the physical layer to provide resilience in the unlicensed 2.4 GHz band, providing a very strong and proven reliable solution for carrying relevant data from device to device, and to the meter or other interface to the grid. In addition, both technologies use acknowledgement mechanisms to improve reliability of communication.

3. Spectrum – how to use it for Smart Grid

- How widely used is unlicensed spectrum? For which applications is this spectrum used?
802.15.4 uses the unlicensed 2.4 GHz and 868/900 MHz bands, providing a good vehicle for Home Area Networking, ensuring innovation and multiple vendors for consumer choice, low cost and reliability.
- Have wireless Smart Grid applications using unlicensed spectrum encountered interference problems?
ZigBee uses unlicensed spectrum in the 2.4 GHz range and has not experienced significant interference problems. There have been many tests on ZigBee and 802.15.4 in the 2.4 GHz spectrum and it has shown to coexist well with other

interferers. As part of the IEEE 802.15 standards, it has to go through coexistence assurance. Mechanisms do exist within the standard to allow frequency agility of ZigBee networks in the event it is needed in future deployments.

4. Real Time Data

- How do consumers access?

ZigBee technology makes real time data available from the meter to devices in the home. The Smart Energy profile enables access through devices in the home which are connected to the meter, through In-home displays (IHDs) and smart thermostats for example.

- How should 3rd party application developers and device makers use this data? How can strong privacy and security requirements be satisfied without stifling innovation?

The ZigBee Alliance has more than 300 members participating in creating ways to use this data for the consumer and utilities. Security requirements are state-of-the-art within the Smart Energy protocol and provide utility-level security while enabling the type of innovation needed to satisfy existing market requirements and stimulating new ones.

- What uses of real time consumption and pricing data have been shown most effective?

There are many pilots showing marked decreases in energy usage by consumers when their consumption data is displayed in their home, and similarly with pricing data. The Alliance encourages the FCC to review these studies to see some of the applications, but also points out that not all uses for this type of data have been shown or proven yet, with many developers creating products and services that may not yet have been considered.

- Are there benefits to providing consumers more granular consumption data?

ZigBee technology leaves open the opportunity for more granular consumption data, with the intent that the technology and underlying specifications should enable this and encourage market action to address products and services demanded by consumers. Customer flexibility and marketplace innovation here is important as we cannot expect to know today what applications maybe developed in the future. Instead, the use of standard interfaces and data types will allow innovation and consumer choice.

- What are the implications of opening real time consumption data to consumers?

Opening data of any kind creates market opportunities for vendors to create products and services to take advantage of this information. This can range from appliances that can self-analyze to optimize and report on potential damage

based on cycling and usage, to simply displaying the information to identify and address patterns of usage. The underlying technology and policy should balance stability while encouraging innovation for better services and products to meet energy needs. Managing privacy and security are also a concern in any data sharing scenario and needs to meet rational standards for adequacy.

5. Home Area Networks

- What types of devices will be connected to Smart Meters? What types of networking technologies will be used? What type of data will be shared?
- The ZigBee Alliance works continuously with multiple demand response vendors, white goods manufacturers, IT developers and many others on supporting devices that work in a smart energy network. Examples of these types of devices include In-home displays, programmable communicating thermostats, and load management devices among others. All use ZigBee IEEE 802.15.4 radio networking technology. Other technologies used will include powerline networking. A list of many of these smart energy devices is highlighted below:*



ZigBee Smart Energy Certified Product Details



The following products with the listed firmware, hardware or SKUs have successfully passed certification. Under ZigBee Alliance certification policy, any changes in firmware or hardware require re-certification.

| Manufacturer | Product Type | Product Name | Firmware Version | Hardware Version | SKU or similar |
|-----------------------|------------------------|--------------------------------|------------------------------|------------------|----------------|
| Alektrona | ESP | Z-Aperture ZA07-200-ESP | V1.0 | V1.0 | NA |
| Computime | Thermostat | CTW200 | 1.0 / Ember ZNet 3.2 | 1.0 / EM250 | NA |
| Computime | In Home Display | CTW300 | 1.0 / Ember ZNet 3.2 | 1.0 / EM250 | NA |
| Converge | Thermostat | SuperStat Pro | 0.01 | EM260 | NA |
| Converge | Load Controller | DCU | 0.01 | EM260 | NA |
| Digi | ESP | ConnectPort X2 ESP | 1.00 | A1 | NA |
| ecobee | Thermostat | Ecobee Smart Thermostat | V1.5.0.126 | 001 | NA |
| Energate | Thermostat | Pioneer Z100 | OS000309-3 | na | NA |
| Energate | Thermostat | Pioneer Z107 | OS000254-B | na | NA |
| Energaware | In Home Display | PowerTab / PowerPortal | 0.9r492 | 1.3 | NA |
| greenbox | ESP | Interactive Energy Management | GreenIPD-15 | na | NA |
| Itron | ESP | Open Way | 1.4.1 | Revision 7 | NA |
| Itron | Simple Metering Device | Open Way Gas Module | 0.2.11 | HW 3 | NA |
| Landis+Gyr | ESP | Gridstream RF Focus AX | 422N/4.25.13.065504-01002007 | Rev. AC | NA |
| LS Industrial Systems | Smart Meter | LK Meter | 1.0 | 1.0 | NA |
| L.S. Research | In Home Display | RATESAVER RS-SE-24-01 | 1.000 | na | NA |
| PRI | Controller | Customer Information Panel | 2 / Ember ZNet 3.2 Build 27 | EM260 V1 | NA |
| PRI | Smart Meter | Horstmann S23 Meter Interface | 1 / Ember ZNet 3.2 Build 27 | EM260 V1 | NA |
| Tendril | Load Controller | Volt | 1.0.2b1706 | P3 version 2 | NA |
| Trilliant | ESP | SecureMesh Micro Access Portal | 1.0 | 1.0 | NA |

- Which type of devices will be connected to the Internet? What type of networking technologies will be used? What types of data will be shared?
- ZigBee is currently working to incorporate IP addressability for Smart Energy, and is working closely with the IETF (IP standards body) to leverage 6LoWPAN and ROLL for this networking component. ZigBee Home Area Networks will have*

shared access between the internet as well as a utility backhaul system. The utility system will be used for meter data and management and utility specific functions. For those homes with other internet access this can be used for the utility data but also for 3rd party services, comparison of energy usage data, firmware updates and other services.

Respectfully submitted,

/s/

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